

**AN EVALUATION OF WHITE RIVER
NATIONAL WILDLIFE REFUGE'S
FOREST HABITAT MANAGEMENT PROGRAM**

REVIEW TEAM REPORT

JULY 1990

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GENERAL REFUGE INFORMATION

Physical Features

White River National Wildlife Refuge is located within Arkansas, Monroe, Desha and Phillips counties in east-central Arkansas. It is located within the flood basin of the lower White River just a few miles above its' confluence with the Mississippi River. The 112,543-acre refuge is 3 to 10 miles wide and extends along the White River for approximately 65 river miles. Flood waters from the White and Mississippi Rivers annually flood the refuge for as much as six months of the year. Of the total refuge acreage, 90% is forested, 9% is in waterways and lakes and 1% is in agriculture.

In general, the topography of the refuge is typical of flood-prone bottomlands, with wide flats broken by low ridges and swales. Bayous, oxbow lakes and sloughs are common throughout the refuge. Elevations range from 135-170 feet Mean Sea Level (MSL) with 98% of the land area falling below the 160-foot contour.

Climatology

White River Refuge has long, hot, and highly humid summers because of the moisture brought in from the Gulf of Mexico. Winters are generally mild, although occasionally short periods of arctic weather occur. Temperatures can range from extreme highs of 102 degrees to extreme lows of 0 degrees F. The average precipitation is 53 inches a year. Of this, approximately 32 inches, or about 60% of the annual precipitation, falls during winter and spring. Thunderstorms occur on about 50 to 55 days a year, and most occur during the spring and summer. The average annual snowfall is usually less than 4 inches and usually melts within a 24 hour period.

Soil Types

The dominant soil type throughout the refuge is the Sharkey Clay. The soil is slightly acid to mildly alkaline in the surface layer and neutral or mildly alkaline below. The organic matter content of the soil ranges from medium to high and is rated as being high in natural fertility. The Sharkey Clay soil type is found to be associated with several other minor soil types throughout the refuge with the Acadia Silty Clay being most prominent in this association. Because of the nature of these soils (seasonal contraction and expansion) and frequent and prolonged flooding, they are best suited for timber production and wildlife habitat.

Vegetative Types

White River Refuge contains approximately 101,000 acres of forested lands of which 100,000 acres (99%) is in bottomland hardwood and 1,000 acres (1%) is in upland hardwood. Except for the small acreage of upland hardwood the entire refuge is classed as Palustrine, Forested Wetlands according to the Classification of Wetlands and Deepwater Habitats of the United States(FWS/BS-79/31). The forested habitat on the refuge is dominated by 13 different timber types with Oak-Elm-Ash and Overcup oak-Bitter pecan types occupying about 75% of the total forested area.

Early Land Use

This area of the country was settled during the 1840's. The river bottoms were somewhat isolated and remained relatively unchanged until the early 1900's when lumber companies began acquiring large tracts of the river bottoms. Rising timber prices caused the bottoms to be logged for cypress and other desirable tree species. During this period, stockmen ran hundreds of cattle and thousands of hogs in the bottoms and the lumber companies made no effort to control hunting.

The need for a chain of waterfowl refuge areas down the Mississippi flyway was recognized during the drought years of the early 1930's. The White River bottoms were reported as being favorable for a refuge site and negotiations began with lumber companies holding the land. On September 4, 1935 White River National Wildlife Refuge was established by executive order number 7173.

FOREST MANAGEMENT (SILVICULTURAL) PRACTICES

The primary purpose of the forest habitat management program at White River National Wildlife Refuge is to provide habitat for waterfowl and endangered species. Although the management of habitat for other game and non-game species receives considerable attention, this is of a lower priority due to mandates dictated by Congress. In providing optimum habitat for the above species, food is a primary consideration. Therefore, an important management objective will be to favor and increase the red oak component in the forest.

It was obvious to the team members, from presentations by the refuge staff and from field observations, that current silvicultural practices on the refuge are, and have to be, dictated by past cutting practices. There appears to have been at least two removal cuts in the past, the last of which was made some 20 years ago. These cuts have resulted in what appears to be a three-aged stand over most of the forest. There is a scattering of very large and apparently older trees, a large number of smaller, mostly pole-sized trees (probably as a result of the first harvest cut), and a large amount of regeneration varying in size from seedlings to small poles.

The refuge staff has recognized the uneven-aged nature of the stands and has initiated a cutting program which attempts to utilize the advance regeneration (seedlings and saplings), increase the stocking of red oaks, and perpetuate the uneven-aged condition. This is done by group selection cutting of some of the larger trees and less desirable pole-size trees to release the regeneration, of which red oaks is a large component, and by selective thinning of individual trees in the pole class. Most of the regeneration openings are less than one-half acre in size. Red oak regeneration is abundant on most of the red oak sites at the present time; however, if this shade-intolerant regeneration is not released most of it will eventually be lost.

The review team feels that the above approach is basically sound and should be continued with one modification: the regeneration openings should be increased in size. The openings should generally be a minimum of 2 acres and a maximum of 5 acres in size. It is felt that these larger openings are necessary first of all to successfully perpetuate the red oaks. Smaller openings are likely to favor the development of more shade-tolerant species rather than the less tolerant red oaks. Also, these larger openings provide better options for future management of wildlife habitat. The larger openings will increase species diversity, speed the development, and improve the quality of the oak component.

Stem removal in all openings should begin at a two-inch diameter to remove competition and permit optimum development of the preferred red oaks. This may be accomplished by requiring the logger to remove the non-commercial stems. In the event that it is impossible to achieve the removal of non-commercial stems by the operator, timber stand improvement (TSI) work must be accomplished in these regeneration openings to remove the non-commercial stems prior to or immediately after timber harvest. Removing the non-commercial stems prior to timber harvest is recommended. This will permit easy access to each stem that otherwise might be hard to reach following a timber harvest operation.

It is suggested that the regeneration openings generally be at least 10 chains apart and that no more than 5 to 10 percent of the area in a stand be in openings of the same age class at any one time. Assuming a 15-year harvest cycle, trees in these openings should be 30 feet or taller when the next harvest cycle may be scheduled. Therefore, openings from one cycle should not influence the location of future regeneration openings.

If timber production was the primary consideration, the best silvicultural procedure would simply be to make large clearcuts to allow the established regeneration to develop. However, this is not a viable alternative since wildlife habitat is the primary consideration. If the recommended suggestion is adopted, refuge wildlife habitat objectives will be met. Regeneration will be provided enough release to assure its perpetuation, at the same time gradually providing openings of a size sufficient for good red oak development.

The team observed some young pole-sized (trees 6"-12" in diameter at breast height) stands in which regeneration is not a consideration at the present time. In terms of stand development, these stands currently need no silvicultural treatment--the current stocking level will allow good development of quality red oaks.

There is a definite need to establish permanent Current Forest Inventory (CFI) study plots to document changes occurring in the forest. Due to the present work load and short period that this work can be accomplished due to flooding, the CFI program (establishing plots) should be contracted out. An active tree harvest program, natural mortality, beaver damage, watershed hydrological changes, etc, are changing the forest, but no one knows how much or exactly in what way. It is especially important that the staff be aware of net forest growth in order for them to make sound decisions about the number and species of trees that can be harvested. Granted, the forest is not intended to provide sustained yields of wood products, but it must

continually allow for the harvest of commercially valuable trees because this is the best management tool that we have to develop and manage forest habitat.

In order to monitor forest condition and detect the degree and direction of change, all trees greater than 2.0 inches in diameter at breast height should be identified and measured on each CFI plot initially and at 10-year intervals. Plot data will allow for evaluation and determine growth trends, mortality, and tree condition (sound or decadent, good growing stock, etc). A narrative for each plot would also describe understory species, stand vigor, and special events such as crown dieback or sediment build up. These factors are important for forest habitat management and evaluations. Special silvicultural treatments such as thinnings, crop-tree release, and inter-species development can also be monitored using the same plots.

Recommendations:

1. Increase the size of regeneration openings. Minimum size should be 2 acres and maximum size 5 acres.
2. Cutting or TSI in regeneration openings should begin at a two-inch diameter.
3. Regeneration openings in the same age class should be at least 10 chains apart.
4. No more than 5 to 10 percent of the forest should be in regeneration openings of the same age class at any one time.
5. Young pole size stands with adequate red oak stocking do not need silvicultural treatment at the present time--providing the current stocking level will permit good development of the red oaks and browse in adjacent stands is sufficient. If additional browse is desired, light thinnings can be made to rectify this situation.
6. Permanent CFI plots should be established throughout the forest to monitor changes occurring in the forest. This work should be accomplished by contracting out to reputable personnel. Plots should be checked and data recorded every 10 years.

FOREST HABITAT MANAGEMENT FOR WATERFOWL

White River NWR was established to provide wintering habitat and sanctuary for waterfowl, with special emphasis on mallards, and Canada geese. The hardwood forests provide the bulk of the wildlife habitat for waterfowl and other species of wildlife that inhabit this refuge.

Many species of hardwood make up the forest community of White River NWR, but the species of greatest importance to larger animals, such as deer, bear, turkey, and waterfowl are the red oaks (Nuttall oak, willow oak, water oak, and cherrybark oak). Overcup oak provides cavities for wood ducks, leaf litter for invertebrates and food for bear, deer and squirrels, but it is of limited food value for waterfowl. Forest habitat management should therefore focus on the red oak group where site management allows, but not to the total exclusion of other species. Since low elevations, which favor the bitter pecan-overcup oak-sugarberry type predominate over much of the refuge, it is important that red oaks and sugarberry are favored where the opportunity exists.

Forest habitat management practices recommended under the Silvicultural Practice Section of this report will insure continued forest diversification and meet the habitat requirements of all the various wildlife species the refuge should be supporting. This combination of forest management actions should also insure the primary objective of providing habitat for wintering waterfowl. Specifically this system of management will address the basic needs of food production, variety of food production, cover for roosting and social interaction, as well as cavities for wood ducks.

Small regeneration cuts (2-5 acres) will insure a variety of herbaceous material on the forest floor that will not exist under a solid forest canopy. The small openings will be especially conducive to annuals such as smartweed, millet, sprangletop, and panicums, which provide a variety of seeds that are important in the diet of waterfowl especially when other crops are poor. They also offer a diverse habitat that favors a variety of waterfowl species. Openings of this size offer landing zones favored by waterfowl, brood-rearing areas for wood ducks, and as succession proceeds, cover utilized for roosting, courtship, and other phases of social interaction.

Dead timber areas resulting from beaver kills should continue to be managed as moist soil areas or roost sites depending on the degree and type of plant succession. If feasible and necessary,

these dead timber areas can also be managed as reservoirs to either provide green timber reservoir (GTR) water or available early fall water.

GTR management should continue with consideration given to the establishment of a rotation system where impoundment of fall water is delayed until after November 1, or as close to mean White River permanent flooding as possible. This should serve to duplicate the natural system as much as possible and relieve some GTR stress. No similar option exists during the spring season because natural flooding overrides what we may do at this time of the year.

Habitat improvement cuts should leave an ample supply of cavity trees for wood ducks and hooded mergansers when marking timber for removal. In addition, consideration should be given to species such as overcup oak, bitter pecan, red maple, cypress and sycamore that generally produce desired cavities. Replacement trees should also be considered. Cavity trees should be especially favored in the vicinity of brood habitat. Contact with Dr. Ed Hill at the Mississippi State University Coop Wildlife Unit should be initiated to find out the relative abundance of cavities suitable for wood ducks on White River NWR.

Present efforts to limit beaver populations should be continued because the 4,500 acres of dead timber represent the upper level of this desired habitat type.

Recommendations:

1. Focus forest habitat management on the red oak group, but not to the exclusion of other species.
2. Use small regeneration cuts (2-5 acres in size) to insure a variety of herbaceous vegetation such as smartweed, millet, sprangletop, and panicums for waterfowl. Openings of this size are also needed for landing zones and as succession proceeds provide cover for roosting, courtship, and brood-rearing habitat.
3. Continue to manage dead timber areas as moist soil and roost sites. If feasible, manage these areas to provide early water for flooding GTR's.
4. Consider setting up a rotation for early flooding of GTR's.
5. Habitat improvement cuts should leave an ample supply of trees that are recognized as good cavity producers for wood ducks and hooded mergansers.

6. Initiate a study to determine the number of good cavities near brood habitat.
7. Continue efforts to control the beaver population. No additional net loss of timber should be the refuges objective in beaver management.

FOREST HABITAT MANAGEMENT FOR ENDANGERED SPECIES

The only Federally listed species known to definitely occur regularly on White River NWR is the bald eagle. Two active nests are located on the refuge. Also, numerous individuals use the refuge each winter. Present refuge operations benefit both the wintering and breeding birds. Both nests are located in areas largely inaccessible to the public and are not subject to disturbance, thus complying with the Service's Bald Eagle Management Guidelines. Establishing a 200-foot buffer strip along major waterways emphasizing overmature hardwoods will serve as additional roosting sites and for potential nest sites.

Two additional listed species, eastern cougar and pondberry, are not presently known to occur on the refuge. However, these species should be sought when cruising forest habitat or during other management activities. Little or no change is expected in present operations if either of these species is found, but informal, intra-Service, Section 7 consultation should be conducted to avoid inadvertent impacts.

Recommendations:

1. A 200-foot buffer strip, emphasizing overmature hardwoods, should be maintained along major waterways for roosting and nest sites for the bald eagle.
2. Management personnel should be on the lookout for the eastern cougar and pondberry when conducting management activities.

FOREST HABITAT MANAGEMENT FOR NONGAME WILDLIFE

Migratory Birds

The management objective of diversifying stand composition and diameter class structure will benefit or will be compatible with most nongame migratory birds occurring on the refuge. The two Natural Areas (1,000 acres and 3,500 acres) plus a primitive

area (6,000 acres) should allow core habitats for those species dependent upon large contiguous stands of over-mature forest. Limiting regeneration cuts to 2-5 acres, with a spacing of no closer than 10 chains to the next regeneration cut in the same age class, should benefit some early successional species such as yellow-breasted chat and white-eyed vireo. Also, regeneration cuts should provide desirable habitat conditions that will benefit red-shouldered hawks and ruby-throated hummingbirds. This management should be compatible with forest interior species as well, such as yellow-billed cuckoo, eastern wood pewee, acadian flycatcher, wood thrush, red-eyed vireo, northern parula and prothonotary warbler, which have shown declining trends within the Mississippi Alluvial Plain during the last 20 years. All these species were detected during the forest review in relatively good numbers, including some of the areas that have been treated recently. White River may be considered a very important "habitat island" for many bird species that utilize the forest interior.

An important concern for birds of the forest interior using habitat islands, even those the size of White River (112,543 acres), is that openings attract brown-headed cowbirds (a nest parasite) and nest predators. These species may disrupt nesting attempts of forest interior birds in adjacent forested patches. Present biological information suggests that forest interior species are unable to maintain their populations within 1/8 mile of a forest edge, which includes agricultural lands, major roadways, and utility right-of-ways. An important consideration in forest habitat management is to avoid forest fragmentation within 1/8 mile of the forest edge. Sparsely placed and very small regeneration cuts (2-5 acres) are unlikely to contribute significantly to cowbird or predator problems on forest interior bird species at White River NWR, however this subject should be studied in more detail.

Three other nongame migratory birds that should be highlighted are the cerulean warbler, Bell's vireo and Mississippi kite. The cerulean warbler is a designated species of national management concern and is generally thought to be the most severely declining neotropical migrant occurring in Southeast bottomland forests. Opportunities may exist to enhance this species' status within White River NWR's natural and primitive areas and along major waterways where mature hardwoods are encouraged. This species prefers forests with a closed canopy and nests at heights in excess of 40 feet. According to initial studies in eastern deciduous forests, no less than 1,750 acres of contiguous forest appear to be required for this species to occur. Thus the site of present and proposed passive management zones on the refuge should attract and hold this species as mature forest continues to develop. Song surveys for this species can be conducted in May or early June to determine where it occurs on the refuge.

Natural regeneration of willow thickets along major waterways should provide important nesting habitat for the Bell's vireo, another Service species of national management concern and presently rare in the White River area. Willows can provide important nesting and foraging habitat from regeneration to old growth for many insectivorous birds. Dense willow thickets also provide good foraging habitat for insectivorous species during migration, as many such birds concentrate their activities in woodlands along waterways.

The Mississippi kite is a species undergoing steep decline in the Mississippi Alluvial Plain, however a healthy population appears to occur on the refuge. This species requires mature hardwoods for placing its nest but primarily forages along forest edges. Maintenance of a 200-foot buffer strip of mature forest along major roadways and agricultural areas should greatly enhance this species' population in east-central Arkansas. Active forest management can be carried out in this buffer strip, however, regeneration cuts should not be made.

Other Nongame Species

The great diversity of forest types in both species composition and structural types (including vertical and horizontal patchiness) should be beneficial for supporting a good diversity of animals and plants throughout the refuge.

Interpretative

White River NWR is an excellent showcase for bottomland hardwood management. The visitor center and office facility should place special emphasis on how forest management is based on the needs and considerations of many wildlife species. Specifics should be given for both game and nongame species.

Management Studies

A specific management study should include the brown-headed cowbird's use of the refuge. Very little specific information exists on cowbird exploitation of forest interior hosts under various habitat manipulations. A study could be set up to determine rates of cowbird use of regeneration cuts at various distances from forest edges, with natural and primitive areas serving as controls. This study should be ideal for a Master's student interested in avian wildlife and forestry. Dr. Thomas Martin at the University of Arkansas USFWS Cooperative Research Unit would be a good person to discuss such a study with.

There is a need to better understand the status of forest interior birds breeding on the refuge for possibly determining if there are differences in their response to passive versus active forest management. Establishing Service breeding bird census plots that are surveyed on a yearly basis may provide some good data in the long-term assessment of forestry practices. Again, Dr. Martin would be a good person to contact. Also The National Fish and Wildlife Foundation is in the process of developing an initiative to fund projects involving neotropical migrant birds. Any study proposals developed should be considered for submission to the Foundation.

Recommendations:

1. Regeneration cuts ranging in size from 2-5 acres will be desirable habitat for certain bird species. These openings should not be made in the 200-foot buffer strip of mature forest adjacent to major roads and streams.
2. Forest habitat management should avoid forest fragmentation within 1/8 mile of the forest edge to discourage brown-headed cowbird activity and provide nesting habitat for the Mississippi kite.
3. A study should be implemented to document the presence or absence of brown-headed cowbird activity in the regeneration cuts. Dr. Thomas Martin at the University of Arkansas, USFWS Coop Research Unit should be contacted for this study.
4. Song surveys can be conducted to determine where the cerulean warbler occurs on the refuge.
5. Stands of black willow should be permitted to develop and grow on certain sites along major waterways to enhance habitat for insectivorous bird species.
6. Breeding bird census plots should be set up and surveyed annually to assess the effects of forest management practices. Plots should be in both active and passive management areas.
7. The National Fish and Wildlife Foundation should be contacted to determine if funding is available for bird studies.
8. A research proposal should be prepared by the refuge staff and submitted to Supervisory Wildlife Management Biologist Bowers to inform him of important research studies that need to be implemented.

FOREST HABITAT MANAGEMENT FOR GAME SPECIES

The forest habitat management goal of encouraging mast production, especially of red oaks, maintaining diversity of tree species, and maintaining all age classes, including overmature trees is accomplished by single-tree and group selection harvest. Under this system, important game species such as deer, squirrel, and turkey, have sustained reasonable annual harvests for many years. The primary factors limiting these species probably are annual flooding, which occurs during critical periods in the natural food cycles and the life cycles of the species, and inadequate open areas providing herbs, shrubs, and vines.

Increased size of small openings, recommended to enhance red oak regeneration, should be very beneficial to most game species. These openings should improve quality and availability of deer browse, increase quality and availability of nesting and brood-rearing habitat for wild turkey, and provide soft fruits such as grape and blackberry for use by bear, raccoon, deer, turkey, and various non-game species. As these openings develop into the thicket stage, they should be attractive cover for bear, deer, and woodcock. These benefits will be ephemeral because of the rapid growth of the vegetation, so new openings must be created at frequent (15-year) intervals within individual subcompartment or at least compartment-sized units.

Although not expected, concentrated deer browsing in these small openings potentially could inhibit oak regeneration. The openings should be monitored for deer damage to oak regeneration, and if it becomes a problem, reevaluation of the size of the openings will be necessary.

Because a canopy is continually maintained over most of the forest, most game populations are fueled by mast, especially acorns. Acorn production varies from year to year, with poor crops occurring about 1 year in 5. The goal of maintaining a diversity of tree species is especially important in providing buffer mast foods for game species in these years. Although the management goal is to favor red oaks, the white oak component (mainly overcup oak) provides a degree of insurance against poor mast crops, and overcup oak is readily eaten by deer, bear, and squirrels. Persimmon, sugarberry, pecan, blackgum, and grape all serve as secondary mast foods for deer, bear, raccoon, squirrel, and turkey. Sweetgum, elms, ash, hornbeams, maples, grasses, and herbs are other alternate mast foods for turkey. All of these except pecan also provide buffer foods for ducks.

Because most of the refuge is flooded in late winter and early spring when foods are scarce, deer and turkey concentrate on the higher elevations. It is important that these areas are given

special management attention to provide the maximum amount of food that is feasible.

Although game harvest management was not examined in detail, the numbers of deer and turkey harvested in recent years seem reasonable, the methods of monitoring the harvest seem adequate, and there is no evident reason for changes in harvest management. Because of the over-riding importance of acorns and water levels on refuge wildlife we recommend that systematic and consistent methods of recording annual conditions be developed. And, we urge that these data, harvest data, and other records of historical value be carefully preserved and maintained indefinitely.

Recommendations:

1. Regeneration cuts or openings should be increased in size to 2-5 acres to enhance game species habitat.
2. New regeneration openings should be created in each compartment at 15-year intervals to maintain habitat diversity for game species.
3. The effect of deer browsing on red oak regeneration should be monitored. If a problem is encountered, the size of openings should be reevaluated.
4. Although emphasis in management should be to favor the red oak group, continue to encourage species diversity of trees, shrubs, and woody vines for variety and stability in mast production.
5. The higher sites (elevation) should be managed to provide the maximum amount of food that is practical since wildlife will be concentrated on these areas when the refuge is flooded.
6. Acorn production and water levels probably have a substantial impact on refuge wildlife. Due to this we recommend that systematic and consistent monitoring of annual conditions be initiated. The data should be preserved and maintained indefinitely.

ADMINISTRATION

The administration section of this review focused primarily on funding, staffing, and equipment needs. As with most refuge field stations, the funding at White River Refuge comes from several different sources, some of which are very specific in their parameters.

A special point of interest is the coordinated work between the refuge biologist and the refuge forester. Because of the education, experience and desire of both of these individuals, the forest habitat management program is being implemented in an exemplary manner. The team feels it is very important, particularly for this refuge, to maintain this combination with the refuge biologist having a background in forestry and the refuge forester having a background in wildlife biology and management. These professionals should work together in planning and implementing the program.

Staffing

The work load on such a large refuge and the limited field time associated with annual flooding creates a major problem in completing necessary annual objectives. To relieve the problems associated with completing the field work, we recommend one additional FTE filled by 2-3 seasonals employed during the dry season when the work load is greatest. Hiring a retired annuitant on a seasonal basis also offers an alternative to the forestry manpower shortage.

Equipment

Refuge equipment is well maintained and stored under sheds. Because of annual flooding and forest habitat management operations, maintenance of the road system requires a major commitment. A small dozer (JD 650 or D-5) is needed to maintain the roads. Some discussion was heard of possible fire funding for this purchase. Because of the lack of fire activity and historical fire problem at this station, this will rank as a low regional priority. Because the dozer will support refuge O & M, funds should come from this source. If this is not possible, a suitable dozer may be available from a refuge that has recently replaced a dozer dedicated to fire use.

When portions of the refuge are flooded, boats serve as the only means of transportation to reach ridges or high ground where timber marking needs to be accomplished. At the present time the forestry staff uses refuge boats and motors to accomplish this. When replacing this equipment thought should be given to replacing these items with expense for sales funds.

The location of new beaver dams and ponds prior to foliage discoloration is essential if the timber on these sites is to be maintained in a healthy condition. Early detection is hard to accomplish using fixed wing aircraft. One possible solution would be to use the Service helicopter or a contract helicopter.

If funds could be designated for this work, possibly some of the refuges close to White River could pool their resources for 1 or 2 days of detection work.

The refuge has only one computer system. This is not adequate to handle the clerical and land management activity. We recommend that a computer dedicated to management activities be purchased. This system should have the capacity to utilize data bases and mapping systems.

General Administration

Annual prescriptions are very detailed, complete and demonstrate a great deal of thought and planning. The Forest Habitat Management Plan will need revision in approximately two years. The staff should begin work on this revision in the near future. Aerial photography of the refuge is limited. Attempts should be made to obtain aerial photography at a scale of 1 inch per mile on a 3 or 5-year cycle. This could be accomplished by cooperation with other federal agencies or by contract.

The refuge staff has a good understanding of the budget process as relates to maintaining roads and bridges associated with timber harvest. It is well understood that bridges and roads may be returned to pre-harvest conditions through the harvest contract, but not be improved past the pre-harvest condition, which would be supplementing their budget.

The complexity and size of this refuge requires a stable professional staff to provide continuity to the habitat management program. The team recommends the staff grade structure be reviewed and evaluated to reflect the complexity of management.

Fire Management

Fire management operations are adequate for a bottomland hardwood refuge. The staff reports 3-5 fires per year, mostly associated with fires on the levee system. The staff is trained in basic firefighting. The team encourages additional training and interagency assignments for career development. All fires on the refuge, or fire assistance given to the state, should be reported on the standard form, DI 1202.

Recommendations:

1. When hiring or replacing biologists and foresters at White River it is recommended that biologists have a forestry background and foresters have a background in wildlife

biology and management. These people should work together when collecting field data for annual prescriptions and forest habitat management plans.

2. One FTE should be added to the forestry staff. This position should be filled by 2-3 seasonals during the dry season. Consideration should be given to hiring a retired annuitant with a background in forest habitat management when filling these positions.
3. Equipment purchased to maintain roads should be acquired with O&M funds.
4. Explore the possibility of using the Service helicopter to locate new beaver ponds prior to foliage discoloration.
5. A computer having the capacity to utilize data bases and mapping systems should be purchased and assigned to the forestry and biological staff.
6. Obtaining field data necessary for revising the Forest Habitat Management Plan should begin in the near future.
7. Aerial photography (1 inch per mile) should be acquired every 3-5 years.
8. Care should be taken when preparing sale contracts to insure that the refuge budget is not supplemented.
9. The refuge staff grade structure should be reviewed and elevated to reflect the complexity of management.
10. Fire management training and interagency assignments to enhance career development should be encouraged.

SUMMARY

The White River NWR staff is commended for its efforts in managing the forest acreage to meet Refuge, Region and Service objectives. Bottomland hardwood management is complex and the fact that the refuge is flooded several months of the year when the forestry staff needs to be working in the field further complicates matters. In an effort to fully utilize their time wisely, office work, such as the preparation of annual prescriptions and other planning efforts are accomplished when the refuge is flooded. A computer is used extensively in processing cruise data. Being able to use this piece of equipment greatly facilitates the amount of work that can be accomplished in a short period of time. This is especially important on a large refuge with a small forestry staff.

The forestry staff is also commended for their efforts in obtaining a market for pulpwood. This greatly enhances the opportunity to do a better job in managing the forest resource. Being able to remove the undesirable stems in this size class through commercial sales expands the opportunity to manipulate forest habitat, increases the revenue received from managing forest wildlife habitat, and reduces TSI expenditures.

The review team was impressed with the enthusiasm and interest the refuge staff exhibited during the evaluation. We feel that the staff is dedicated to doing the best job possible in managing the forest resource to provide the diversity of habitats required by the total wildlife community.

The management practice that probably generated the most discussion was the size of group selection or regeneration cuts necessary to enhance wildlife habitat diversity and also provide conditions necessary to perpetuate the shade-intolerant red oak species. The review team recommended that the number of these regeneration cuts be increased and they should range in size from 2-5 acres. It was felt that the proper spacing of regeneration cuts would not fragment the forest, a condition that needs to be avoided for certain bird species and would provide young stands of sufficient size to attract some bird species that are not normally associated with large blocks of older forest. The openings would also improve habitat conditions for waterfowl, some non-game, and game species.

The review team feels that this refuge has the leadership and expertise to incorporate the recommendations made by the review team.

The recommendations are:

1. Increase the size of regeneration openings. Minimum size should be 2 acres and maximum size 5 acres.
2. Cutting or TSI in regeneration openings should begin at a two-inch diameter.
3. Regeneration openings in the same age class should be at least 10 chains apart.
4. No more than 5 to 10 percent of the forest should be in regeneration openings of the same age class at any one time.
5. Young pole size stands with adequate red oak stocking do not need silvicultural treatment at the present time--providing the current stocking level will permit good development of the red oaks and browse in adjacent stands is sufficient. If additional browse is desired, light thinnings can be made to rectify this situation.
6. Permanent CFI plots should be established throughout the forest to monitor changes occurring in the forest. This work should be accomplished by contracting out to reputable personnel. Plots should be checked and data recorded every 10 years.
7. Focus forest habitat management on the red oak group, but not to the exclusion of other species.
8. Use small regeneration cuts (2-5 acres in size) to insure a variety of herbaceous vegetation such as smartweed, millet, sprangletop, and panicums for waterfowl. Openings of this size are also needed for landing zones and as succession proceeds provide cover for roosting, courtship, and brood-rearing habitat.
9. Continue to manage dead timber areas as moist soil and roost sites. If feasible, manage these areas to provide early water for flooding GTR's.
10. Consider setting up a rotation for early flooding of GTR's.
11. Habitat improvement cuts should leave an ample supply of trees that are recognized as good cavity producers for wood ducks and hooded mergansers.

12. Initiate a study to determine the number of good cavities near brood habitat.
13. Continue efforts to control the beaver population. No additional net loss of timber should be the refuges objective in beaver management.
14. A 200-foot buffer strip, emphasizing overmature hardwoods, should be maintained along major waterways for roosting and nest sites for the bald eagle.
15. Management personnel should be on the lookout for the eastern cougar and pondberry when conducting management activities.
16. Regeneration cuts ranging in size from 2-5 acres will be desirable habitat for certain bird species. These openings should not be made in the 200-foot buffer strip of mature forest adjacent to major roads and streams.
17. Forest habitat management should avoid forest fragmentation within 1/8 mile of the forest edge to discourage brown-headed cowbird activity and provide nesting habitat for the Mississippi kite.
18. A study should be implemented to document the presence or absence of brown-headed cowbird activity in the regeneration cuts. Dr. Thomas Martin at the University of Arkansas, USFWS Coop Research Unit should be contacted for this study.
19. Song surveys can be conducted to determine where the cerulean warbler occurs on the refuge.
20. Stands of black willow should be permitted to develop and grow on certain sites along major waterways to enhance habitat for insectivorous bird species.
21. Breeding bird census plots should be set up and surveyed annually to assess the effects of forest management practices. Plots should be in both active and passive management areas.
22. The National Fish and Wildlife Foundation should be contacted to determine if funding is available for bird studies.
23. A research proposal should be prepared by the refuge staff and submitted to Supervisory Wildlife Management Biologist Bowers to inform him of important research studies that need to be implemented.

24. Regeneration cuts or openings should be increased in size to 2-5 acres to enhance game species habitat.
25. New regeneration openings should be created in each compartment at 15-year intervals to maintain habitat diversity for game species.
26. The effect of deer browsing on red oak regeneration should be monitored. If a problem is encountered, the size of openings should be reevaluated.
27. Although emphasis in management should be to favor the red oak group, continue to encourage species diversity of trees, shrubs, and woody vines for variety and stability in mast production.
28. The higher sites (elevation) should be managed to provide the maximum amount of food that is practical since wildlife will be concentrated on these areas when the refuge is flooded.
29. Acorn production and water levels probably have a substantial impact on refuge wildlife. Due to this we recommend that systematic and consistent monitoring of annual conditions be initiated. The data should be preserved and maintained indefinitely.
30. When hiring or replacing biologists and foresters at White River it is recommended that biologists have a forestry background and foresters have a background in wildlife biology and management. These people should work together when collecting field data for annual prescriptions and forest habitat management plans.
31. One FTE should be added to the forestry staff. This position should be filled by 2-3 seasonals during the dry season. Consideration should be given to hiring a retired annuitant with a background in forest habitat management when filling these positions.
32. Equipment purchased to maintain roads should be acquired with O&M funds.
33. Explore the possibility of using the Service helicopter to locate new beaver ponds prior to foliage discoloration.
34. A computer having the capacity to utilize data bases and mapping systems should be purchased and assigned to the forestry and biological staff.
35. Obtaining field data necessary for revising the Forest Habitat Management Plan should begin in the near future.

36. Aerial photography (1 inch per mile) should be acquired every 3-5 years.
37. Care should be taken when preparing sale contracts to insure that the refuge budget is not supplemented.
38. The refuge staff grade structure should be reviewed and elevated to reflect the complexity of management.
39. Fire management training and interagency assignments to enhance career development should be encouraged.